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Received for publication 8 January 1993; revised and accepted 17 April 1993.

Journal of the Lepidopterists' Society
47(4), 1993, 323–327

NOTES ON THE NATURAL HISTORY OF *ACHLYODES SELVA* (HESPERIIDAE) IN COSTA RICA

Additional key words: life cycle, seasonal abundance, larval behavior.

Skippers of the widely distributed Neotropical genus *Achlyodes* Hubner 1819 exploit various Rutaceae, including cultivated *Citrus* Linnaeus 1735, as caterpillar food plants (Moss 1949, Kendall 1965, Kendall & McGuire 1975, Biezanko et al. 1974, Beutelspacher 1980). In spite of its broad distribution in Central America, Mexico, and South America (Evans 1953), *A. selva* Evans is poorly studied. In this note I report certain aspects of the natural history of *A. selva* in Costa Rica.

Between September 1985 and March 1991, *A. selva* was studied at a *Citrus* bush (approx. 2.0 m tall) located on the campus of the University of Costa Rica in San Pedro Montes de Oca (9°57'N, 84°01'W), San José, San José Province. An initial examination of this bush revealed the presence of several hesperiid larvae concealed in tent shelters, prompting me to rear the caterpillars to the imago and identify the skipper. Subsequent examinations of this bush were conducted to record the abundance of caterpillars, pupae, pupal shells, and tent shelters. The abundance of flush leaves on the bush, easily distinguished from older, dark green leaves by their yellow-green color, also was recorded. At various times small numbers of caterpillars were collected and reared in clear-plastic bags containing cuttings of citrus. Caterpillar behavior in the wild and captivity was noted, especially with regard to shelter construction.

Early stages. Egg not observed. Larva in all instars with strongly dorso-ventrally flattened body profile. Head capsule strongly lobed (heart-shaped) and reddish-brown in all instars, with paired black spots laterally at base. Legs yellowish. Ground color of body bluish-green, with a lemon-yellow collar or integumental fold between body and head capsule. All instars (Fig. 1) with a bright yellow dorso-lateral line running along each side of the entire body length, consisting of closely spaced irregular shaped slashes. Anal clasper and plate with a lateral yellow ridge. The third to the last body segment bears dorsally a median cluster of small yellow dots. No pronounced changes in the color of the larva between earlier and later instars. Very similar to the description of the larva *A. thraso* Hubner, but considerably different from that of *A. busirus* (Cramer) (Moss 1949). From an initial body length of 3–4 mm, the mature larva attains a body length of 45–48 mm in about 25 days. The reddish-brown stout pupa is about 21 mm long and covered with a bluish-white flocculence or bloom (see also Moss 1949), and lasts about two weeks. There is little sexual dimorphism in adult wing size and color (Fig. 1).

Larval behavior. Larvae in all instars construct individual tent shelters in which they perch while not feeding. Larval feeding was not observed in the wild. In late instar larvae, this shelter is often made by anchoring two adjacent large leaves together with silk (Fig. 1). The larva perches on a thin silken webbing on the dorsal surface of the lower leaf and over which is tied a second leaf in a partially overlapped manner (Fig. 1). Shelters

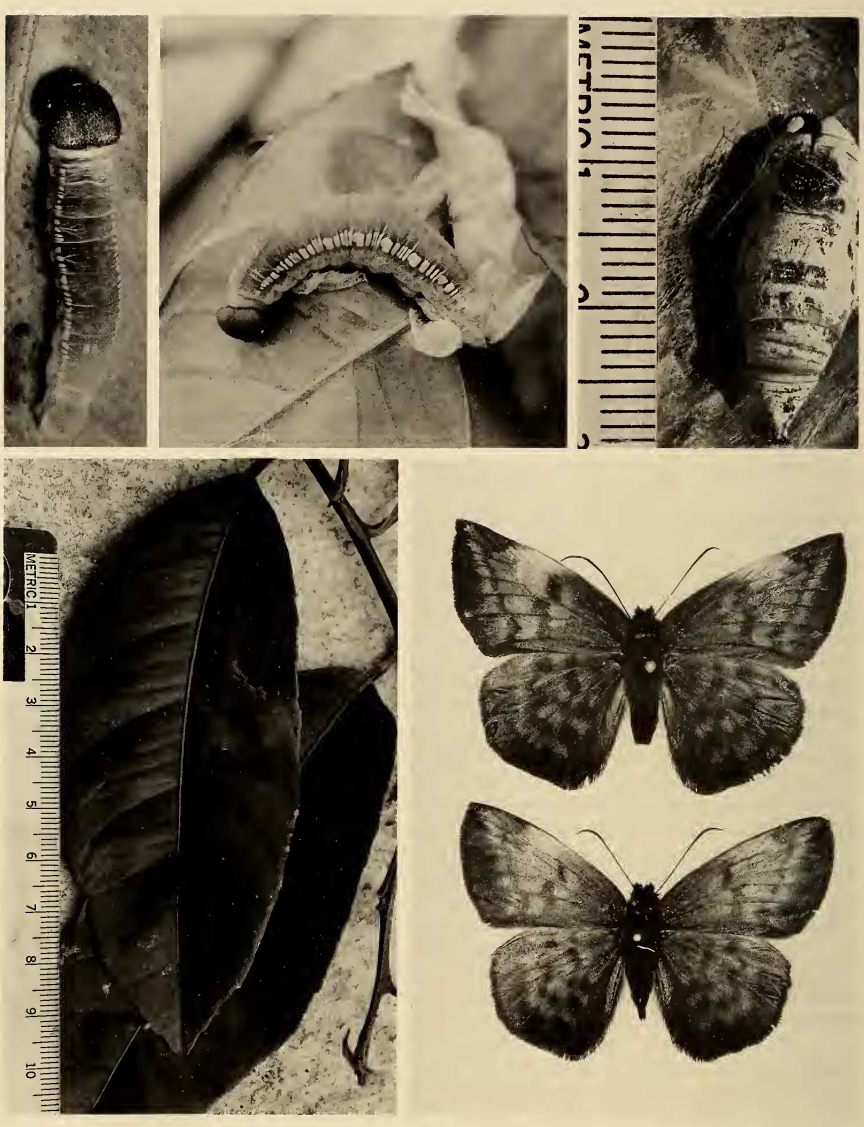

FIG. 1. Some aspects of life cycle and larval behavior in the Neotropical skipper *Achlyodes selva* Evans in Costa Rica. Clockwise, from upper left: early instars of the larva; pupal shell inside opened tent shelter, and showing whitish bloom; shelter made by a large larva pulling together and anchoring with silk two large leaves of *Citrus*; adult female (above), male (below).

of this size and arrangement often contain pupae and empty pupal shells (Fig. 1). Empty pupal shells equate to successful eclosions. No mummified or otherwise dead pupae were found, even though parasitism occurs (see below). All pupa cases were found inside shelters made with mature leaves. Small larvae make the shelter by partially excising a piece of

TABLE 1. Censuses of caterpillars, pupae, pupal shells, and larval shelters of *Achlyodes selva* Evans 1953 on a lone *Citrus* shrub, San José, Costa Rica, in relation to different time of the year and affiliated leaf flushings.

Census date	% of flush leaves	Nos. of caterpillars						No. of pupae	No. of pupal shells	No. of empty larval shelters
		Instar 1	2	3	4	5	Total			
20-IX-85	25%	8	6	5	3	3	26	2	6	10
19-II-86	0%	0	0	0	0	0	0	0	2	3
5-VIII-86	30%	3	5	2	6	6	22	0	1	8
9-XI-86	15%	0	0	4	3	2	9	0	4	5
11-III-87	20%	2	2	0	0	0	4	1	6	4
24-VI-87	15%	0	3	2	2	0	7	1	3	5
21-II-88	5%	0	0	1	2	0	3	0	8	6
16-VI-88	20%	3	1	2	1	0	7	0	2	4
15-II-89	25%	0	0	0	0	0	0	1	1	2
14-IX-89	20%	4	2	4	3	2	15	2	4	6
26-II-90	20%	0	0	0	0	0	0	0	2	1
4-IV-90	10%	2	1	1	3	0	7	1	1	5
29-IX-90	25%	5	4	5	4	2	16	2	4	8
11-III-91	15%	0	0	0	0	0	0	0	1	2

leaf tissue along the edge, folding it over, and anchoring it with silk to the dorsal or upper leaf surface. As the larva grows, it abandons the smaller shelter and builds successively larger ones on the same and adjacent leaves. It is not uncommon to encounter many unoccupied but fully intact larval shelters on the food plant, as also noted for other Neotropical skippers exhibiting a similar behavior (e.g., Young 1991). In the smaller shelters, the larva rests on the ceiling formed by the flipped-over and tied leaf fragment. Larval body length expectedly appears correlated with length of tent shelters. An 11 mm long larva occupied a 19 mm long shelter; a 12–15 mm long larva was found in a 24 mm shelter, a 20 mm long larva in a 28 mm long shelter, and a 45 mm long (mature) larva was found in a 55 mm long shelter. Four mature larvae transported to Wisconsin gave an opportunity to observe tent-building behavior on prickly ash, *Zanthoxylum americanum* Mill. (Rutaceae), which they accepted and fed upon. Because mature prickly ash leaves are much smaller than mature *Citrus* leaves, shelter construction was different on the former food plant. Larvae confined in a plastic bag with prickly ash cuttings constructed shelters in the creases or folds of the bag, rather than in the leaves. In one instance a larva anchored two leaves in a cup-like configuration and used the flat surface of the bag as the rest of the shelter.

Larval abundance. Based upon several examinations of the *Citrus* bush between September 1985 and March 1991, it appears that larvae of *A. selva* are most abundant during the wetter times of the year, i.e., August–September, at this locality (Table 1). These periods correspond roughly with the highest incidents of new, flush leaves on the *Citrus* bush (Table 1). Even though high numbers of flush leaves occur at other times, such as a dry period in February, larval numbers are generally lowest at the drier times of the annual rainfall cycle at this site (Table 1). Such patterns are expected to vary considerably among different Costa Rican populations of *A. selva*, given the highly catholic geographical distribution of this skipper. Examination of specimens of *A. selva* in the Instituto Nacional de Biodiversidad (Inbio) collections in 1986 revealed diverse Costa Rican localities such as Escazu, Alajuela, Guanacaste, and Monteverde. The Allyn Museum of Entomology collection has specimens of *A. selva* from Limon Province, San José, and Santa Cruz in Costa Rica, in addition to specimens from El Salvador, Guatemala, and Mexico. Undoubtedly this widespread species occurs at many other localities in Costa Rica and Central America.

Various rutaceous larval food plants have been reported previously for *A. selva* and other species of this widespread Neotropical genus (Kendall 1965, Kendall & McGuire 1975, Biezanko et al. 1974). Larval food plants for this skipper in Costa Rica very likely include several species of *Xanthoxylum* in addition to cultivated *Citrus*. *Zanthoxylum* is a known food plant of *A. thraso tamenund* (Edwards) in southern Texas (Kendall 1965). *A. thraso* in Brazil has been recorded on *Citrus* and other Rutaceae (Moss 1949). The acceptance of prickly ash leaves by almost full-grown larvae of *A. selva* indicates its ability to feed on a temperate-zone *Zanthoxylum*.

Shelter building in *Achlyodes* larvae using their food plant leaves is well documented or noted in the literature (e.g., Moss 1949, Kendall & McGuire 1975). The precise function of such behavior, widespread and common among skippers, remains unknown. Both the larval and pupal stages of *A. selva* have been recorded as being parasitized (Kendall & McGuire 1975), suggesting that tent shelters of the larvae do not completely block parasitism. These shelters might be effective in concealing skipper larvae from insectivorous birds and lizards. It is unclear as to whether or not these shelters, which conceal or hide both larvae and pupae, reduce parasitism or other kinds of predation. In the present study, one larval shelter was packed with the 4 mm long cocoons, arranged in four rows of seventeen each, of an undetermined hymenopterous parasite, and a second one containing a row of six cocoons. The use of several different tent shelters in sequence by a larva, in which abandoned shelters are left intact, may reduce the effectiveness of searching behavior by predators or parasites, since time is lost checking unoccupied shelters for hosts or prey, as noted in another lepidopteran (Ruehlmann et al. 1988). Abandoned larval shelters of *A. selva* persist for many months, perhaps setting up a passive defense system by slowing down the rate with which predators or parasites locate larvae.

The occurrence of small larvae, and larval shelters, on the yellowish-green meristem leaves of *Citrus* in the present study suggests that *A. selva* females selectively oviposit on these leaves, and less so on darker green, mature leaves. Young leaves often have higher levels of water and nitrogen than older leaves on the same plant and larvae grow faster and achieve a higher body weight on meristem leaves (Pullin 1986). Population cycles of *A. selva* may be regulated to some extent by the annual cycle of peak production of flush leaves on its larval food plants. At least one Costa Rican butterfly species "anticipates" annual epics of peak meristem leaf availability by laying its eggs selectively on tiny leaf buds (Young 1983). Adults possibly mate near the end of the rainy season or early into the dry season, with gravid females entering into a phase of egg diapause until the rainy season commences. Mating pairs of *Achlyodes* sp. have been observed near Liberia, in Guanacaste Province, Costa Rica under shaded trees along the Pan-American Highway in the dry season (A. Young, S. Borkin, and J. Jass, pers. obs. Feb. 1984).

Kendall (1965) observed oviposition by *A. thraso tamenumd* on *Zanthoxylum* in southern Texas but did not mention if eggs were placed on young or old leaves. *A. selva* probably oviposits on meristem leaves of its larval food plants, given the observation that young larvae, and their leaf shelters, occur most frequently on these leaves, and not on mature foliage. While females may prefer young leaves when available, oviposition may also occur on older leaves when meristem leaves are scarce or absent during the year. Empty egg shells of *A. selva* have been found on the older dark green leaves of *Citrus* in El Salvador (Stephen R. Steinhauser, pers. comm.). Both visual and chemical differences between meristem and older leaves (e.g., Saxena & Prabha 1975, Khattar & Saxena 1978) may guide females to oviposit chiefly on meristem leaves when they are available for rutaceous-feeding skippers, similar to what is known for swallowtail butterflies exploiting these plants (Vaidya 1969).

This research was funded in part by the American Cocoa Research Institute of The United States of America and the Milwaukee Public Museum. I thank Marc Minno and Roy Kendall for their expert assistance with confirming the species, and for their many helpful suggestions. Lee and Jacqueline Miller provided locality records for specimens in the Allyn Museum collection, and A. Solis allowed me access to the Inbio collection in Costa Rica for the same purpose. Roy Kendall generously provided me with key references and other helpful insights on this skipper, and reviewed a draft of the manuscript. Two Journal reviewers, who chose to forego anonymity, Drs. Stephen R. Steinhauser and Don

MacNeill, made many helpful suggestions to improve the manuscript. I thank Pat Manning for typing the manuscript.

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Received for publication 12 February 1993; revised and accepted 18 April 1993.